High-sensitivity High-resolution Portable Raman Spectrometer

Feature:
- Ultra-high sensitivity FFT-CCD TE-cooled;
- Low noise circuit;
- Powerful embedded software;
- Fluorescent background eliminate;
- Peak finding and display;
  - Win 10 operation system;
- USB 2.0;
- User friendly human-machine interface;
- Remote control via LAN;

Application:
- Biological science
- Pharmaceutical engineering
- Forensic analysis
- Agriculture and food safety
- Gemstone
- Environmental science

Description:
EOC-SI-R3110-XXXX Raman Spectrometer is TE-cooled, high-sensitivity, enhanced designed for broadband ranges. All of optical path, PCB, signal processing method have been made optimized processed to obtain >15 times higher SNR than ATR20007, nearly 100 times higher than 2000cm-1. EOC-SI-R3110-XXXX employs low noise CCD signal process circuit, noise <3 counts.
EOC-SI-R3110-XXXX employs 110/220V power supply, DC supply via 5V adaptor. Easy to take and field operation.

<table>
<thead>
<tr>
<th>PN</th>
<th>Wavelength (nm)</th>
<th>Wavenumber range cm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOC-SI-R3110-XXXX-473</td>
<td>473</td>
<td>150-4000</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-532</td>
<td>532</td>
<td>150-4000</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-785-27</td>
<td>785</td>
<td>150-2600</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-785-40</td>
<td></td>
<td>150-4000</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-830</td>
<td></td>
<td>150-4000</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-1064</td>
<td></td>
<td>150-4000</td>
</tr>
</tbody>
</table>

Available in custom made wavelength

Remark:
- Measuring method is based on ASTM E2529-06;
- Available in custom design, resolution can be increased by around 1/3, resulting in lower sensitivity.
## 1 Specifications

<table>
<thead>
<tr>
<th>EOC-SI-R3110-XXXX System</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Windows</td>
</tr>
<tr>
<td>Integration time</td>
<td>1ms - 120s</td>
</tr>
<tr>
<td>Power voltage</td>
<td>DC 5V(+/-5%)</td>
</tr>
<tr>
<td>Operating Temp</td>
<td>-10~40 °C</td>
</tr>
<tr>
<td>Operating humidity</td>
<td>&lt; 95%</td>
</tr>
<tr>
<td>Dimension(L<em>W</em>H)</td>
<td>40×30×18 cm³</td>
</tr>
<tr>
<td>Weight</td>
<td>7.5 Kg</td>
</tr>
</tbody>
</table>

### Reliability
- Spectral stability: $\sigma/\mu < 0.5\%$  (COT 8 hours)
- Temp stability: Spectral shift $\leq 1$ cm⁻¹ (10-40 °C)
- Variation of intensity (in 5 ~ 40 °C): <±5%

### Optical parameters
- Spectral range (cm⁻¹): 150-2600  | 200-3500  | 200-4300
- Resolution (cm⁻¹): 5  | 6  | 6
- SNR >3000:1 (918 cm⁻¹ of Acetonitrile, 10s accumulation, 200mW)
- Entrance slit | 50 μm |
- Optical system: f/4  C-T crossed optical path
- Focusing: 98 mm for incidence and output

### Detector
- Item: Ultra-high sensitivity, quick cooling CCD
- Detector cooled down to | -10 °C |
- Detecting range | 200-1100 nm |
- Effective pixels | 2048*64 |
- Dynamic range | 50000: 1 |
- Pixel size | 14μm×200μm |

### Exciting Laser
- Central wavelength | 785nm (+/-1nm) |
- FWHM | 0.08 nm |
- Power output | ≥500 mW |
- Power stability: $\sigma/\mu <\pm 0.2\%$

### Raman probe
- Operating distance | 6 mm |
<table>
<thead>
<tr>
<th>Rayleigh scattering resistance</th>
<th>OD&gt;8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical Aperture</td>
<td>0.3</td>
</tr>
<tr>
<td>Aperture</td>
<td>7mm</td>
</tr>
</tbody>
</table>

## 2 Optical Performance

### 2.1 General spectral performance

![Raman spectra of acetonitrile](image)

*Figure 1 Raman spectra of acetonitrile*
2.2 Spectral Resolution

2.2.1 Raman spectral of Tylenol

Laser Power 200 mW
Integration time: 10 s
Filter level 1

Raman spectra of Tylenol showed the resolution condition in the long wavelength region. That is better than 6 cm⁻¹.
2.2.2 Raman spectral of petrol

Laser Power 200 mW
Integration time: 10 s
Filter level 1

Raman spectra of petrol 93# showed the resolution condition in the short wavelength region.

Fig. 2.2 Raman spectrum of Tylenol, the vibration mode 1610/1615 cm\(^{-1}\) can be resolved.

Fig. 2.3 Raman spectrum of petrol 93#, the vibration mode 723/732/742 cm\(^{-1}\) can be resolved.
3 Reliability

Figure 3.1 and Figure 3.2 showed the temperature reliability testing results of fives EOC-SI-3000 portable Raman spectrometers. The testing temperature range was from 5 °C to 40 °C. The spectrometer was kept more than 1 hour at every temperature spots. Acetonitrile was used as the standard sample in the testing. The testing results were calculated using 918 cm⁻¹ of acetonitrile. The wavenumber shift was 1 cm⁻¹ or less (as show in Fig. 3.1). The peak intensity variation was less than 10% (as show in Fig. 4).

Temperature range: 5-40 centigrade
Wavenumber shift: < 1 cm⁻¹

Fig. 3.1 Wavenumber shift results testing from 5 °C to 40 °C of fives EOC-SI-3000 portable Raman spectrometers

Temperature range: 5-40 centigrade
Spectral intensity variation: < 10%

Figure 4 Intensity variation testing from 5 °C to 40 °C of three EOC-SI-3000 portable Raman
Figure 5 Intensity variation -10 °C to 40 °C of EOC-SI-R3110-XXXX portable Raman spectrometers, sample is alcohol.

2. Measuring accessories

Fig 1 Fluid sample cell (Thermo bottle)

Fig 2 Solid, powder measuring probe
Fig 2 Fluid sample cell (Liquid chromatography bottle) *(Optional)*

Fig 5 Raman probe gun *(optional)*
3. Other excitation wavelength:
<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Excitation Wavelength (nm)</th>
<th>Maximum laser power (mW)</th>
<th>Spectral range (cm⁻¹)</th>
<th>Resolution (cm⁻¹)</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOC-SI-R3110-XXXX0-27</td>
<td>785</td>
<td>550</td>
<td>200-2500</td>
<td>8</td>
<td>Available for most application</td>
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<tr>
<td>EOC-SI-R3110-XXXX0-35</td>
<td>200-2500</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>EOC-SI-R3110-XXXX0-43</td>
<td>200-4300</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-1064</td>
<td>1064</td>
<td>500</td>
<td>200-2600</td>
<td>13</td>
<td>Fluorescence-free, non-destructive, high-sensitivity, high-SNR,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Available samples: dark-color samples, fluorescence sample, bacteria,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>plastic, fuel, petroleum product, vegetable oil, explosive etc.</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-830</td>
<td>830</td>
<td>550</td>
<td>200-3300</td>
<td>7</td>
<td>higher skin permeance suit to biological samples, eg. Non-invasive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>blood glucose, early cancer diagnosis</td>
</tr>
<tr>
<td>EOC-SI-R3110-XXXX-266</td>
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<td>50</td>
<td>200-3000</td>
<td>25</td>
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<td>532</td>
<td>100</td>
<td>200-3200</td>
<td>10</td>
<td></td>
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<tr>
<td>EOC-SI-R3110-XXXX-633</td>
<td>633</td>
<td>80</td>
<td>200-3200</td>
<td>10</td>
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</table>